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# **NAVAL POSTGRADUATE SCHOOL**

## **Monterey, California**



### **THESIS**

**ANALYSIS OF NAVAL FLIGHT OFFICER SELECTION,  
ASSIGNMENT, AND FLIGHT SCHOOL COMPLETION  
AMONG U.S. NAVAL ACADEMY GRADUATES**

by

Ferdinand G. Hafner

June 2000

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Gregory G. Hildebrandt  
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There are three models analyzed in this study. The first two models attempt to determine whether academic rank, military rank, and major are predictive of NFO service selection and NFO assignment. The goal of the third model, which predicts NFO completion, is to determine whether academic and military grades, major, personality, gender, and race predict completion of NFO flight training. Logistic regression is used to analyze the effect of the explanatory variables on the dependent variables.

The analysis shows that the first two models are not statistically significant predictors of NFO service selection and NFO service assignment. The NFO completion model displays the most interesting result of all three models. Military quality point rating is a highly significant predictor of completing NFO flight training. For midshipmen who select NFO as their first or second choice, the higher their military grades the more likely an Academy graduate will complete flight officer training. Further research is recommended to determine if military quality point rating is a significant predictor of completing one's initial training in other warfare communities.

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ASSIGNMENT, AND FLIGHT SCHOOL COMPLETION AMONG  
U.S. NAVAL ACADEMY GRADUATES**

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Submitted in partial fulfillment of the  
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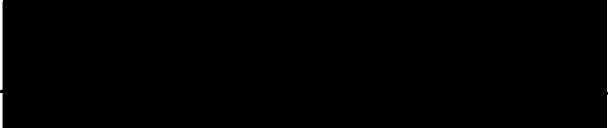
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## **ABSTRACT**

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## TABLE OF CONTENTS

I. INTRODUCTION. ....	1
A. BACKGROUND. ....	3
B. OJECTIVE ....	5
C. SCOPE ....	5
D. HYPOTHESES. ....	7
E. ORGANIZATION ....	7
II. LITERATURE REVIEW.....	9
A. NAVAL FLIGHT OFFICER TRAIING REVIEW. ....	9
B. AFFECTS OF COLLEGE MAJOR AND GPA DURING FLIGHJT TRAINING.....	11
1. GPA as a Predictor of Completion During Aviation Indoctrination.....	12
2. The Academic Potential of Flight Officers. ....	13
C. AFFECTS OF GENDER ON COMPLETION RATES.....	15
D. ACADEMIC MAJOR AND SERVICE SELECTION AT USNA .....	17
E. PERSONALITY AND FLIGHT TRAINING.....	19
1. MBTI Types Among Academy Midshipmen.....	21
2. Successful MBTI Types in Flight Officer Training.....	21

III. DATA ANALYSIS.....	25
A. BACKGROUND.....	25
B. VARIABLES.....	26
1. Dependent Variables.....	27
2. Independent Variables.....	29
C. MODEL SPECIFICATION.....	31
1. MIDN1 and MIDN2 Models.....	32
2. NFO Completion Model.....	34
D. HYPOTHESIS SPECIFICATION.....	35
E. PRELIMINARY ANALYSIS: MIDN1 MODEL.....	37
1. Means: MIDN1 Model.....	38
2. Crosstabulations: MIDN1 Model.....	39
F. PRELIMINARY ANALYSIS: MIDN2 MODEL.....	41
1. Means: MIDN2 Model.....	42
2. Crosstabulations: MIDN2 Model.....	43
G. NFO COMPLETION MODEL.....	46
1. Means: NFO Completion Model.....	47
2. Crosstabulations: NFO Completion Model.....	48
H. SUMMARY.....	56

IV. LOGISTIC REGRESSION ANALYSIS.....	59
A. LOGISTIC REGRESSION MODEL.....	59
B. BINOMIAL LOGIT ESTIMATION:    MIDN1 MODEL.....	60
C. BINOMIAL LOGIT ESTIMATION:    MIDN2 MODEL.....	62
1. Refining the MIDN2 Model.....	64
D. BINOMIAL LOGIT ESTIMATION:    NFO COMPLETION MODEL...	65
1. Interpretation of the Coefficient for 'cmqpr1'.....	67
2. The Refined NFO Completion Model.....	68
E. SUMMARY.....	71
V. CONCLUSIONS AND RECOMMENDATIONS.....	75
A. CONCLUSIONS.....	75
B. LIMITATIONS OF THE STUDY.....	76
C. RECOMMENDATIONS.....	77
APPENDIX A.....	79
APPENDIX B.....	81
APPENDIX C .....	83
APPENDIX D.....	85
LIST OF REFERENCES.....	89
INITIAL DISTRIBUTION LIST.....	91



## I. INTRODUCTION

The purpose of this study is to determine if gender, ethnicity, academic performance and major, military grades, or personality type are predictors of service selection, service assignment, and completing Naval Flight Officer training for graduates of the U.S. Naval Academy. It is often argued that the higher one's academic or military class standing, the greater the chance that one will complete flight training. Another belief is that a person with higher academic or military grades is more qualified to be selected for flight training. The importance of a technically oriented major has also been emphasized. In part, this is based on the belief that students who are educated in engineering, math, physics, and other technical fields are better prepared for flying duty.

This study examines U.S. Naval Academy graduates who were selected for NFO training. The service selection process has been revamped since 1997 and now includes an interview before a board of officers from different communities who determine suitability of a midshipman for a particular community. This interview includes, as it did prior to its implementation, a review of academic and military performance. The majority of selectees for aviation

training are above average midshipmen in both academics and military performance.

The goal of this thesis is to determine whether higher grades and a technical major are significant predictors for completing flight training. Prospective flight officers are also evaluated by a series of aviation tests, which include a biographical inventory to identify personalities suitable for aviation. This study will not utilize the biographical inventory scores, but will examine Myers Briggs Type Indicators (MBTI) to determine if a statistical significance exists for one type of personality among midshipmen who are selected for flight officer training. Gender and ethnicity are also included to test the hypothesis that there is no statistical difference between gender or ethnicity and completing flight training.

The Naval Academy places a strong emphasis on academic and military performance. In an institution that espouses a competitive and challenging environment as preparation for the Fleet, such performance measurement standards are necessary. It is interesting, therefore, to examine whether higher performance grades among midshipmen at the Academy equate to higher completion rates during flight officer training. If the analysis shows that these factors are not statistically significant, then the weighting assigned to

these factors in selecting future flight officers should be reviewed.

#### **A. BACKGROUND**

I. Naval Flight Officer (NFO) training consists of four stages: aviation indoctrination, primary, intermediate, and advanced training. Aviation indoctrination consists of academic training in three courses: basic engines theory, basic aerodynamics, and fundamentals of air navigation. It also includes physical training, aviation physiology, and survival training to determine suitability for flying duty. All are beyond the scope of this study.

Prospective flight officers who pass the aviation indoctrination stage move into primary flight training at Pensacola, Fl. Primary training consists of academics (ground school), simulator training and actual in-flight training. Ground school courses include visual and instrument navigation, meteorology, communication procedures, computer systems, and radar fundamentals. During simulator training, NFO students learn how to navigate and operate various aircraft systems while conducting necessary in-flight duties. While training in-flight they are responsible for the safe navigation and basic tactical deployment of the aircraft.

Following primary training, and depending on preference, class rank, and the needs of the Navy, students proceed to intermediate training in jets or maritime patrol aircraft. Helicopter crews do not have NFOs. Students selected for jet training proceed through the intermediate training syllabus in Pensacola. This training includes more academic training and in-flight training in a complex aircraft. Students who successfully complete intermediate jet training select their jet type, which is again based on the needs of the Navy, preference, and class rank. Students in advanced jet training specialize into different programs based on aircraft type. The emphasis during this advanced stage is on visual and radar navigation and advanced tactical maneuvering. Successful completion of this stage marks the completion of flight officer training and designation as an NFO prior to moving on to fleet readiness training.

Students who select maritime patrol aircraft begin interservice navigator training with the Air Force at Randolph Air Force Base, Texas. Students receive in-flight and simulator training, academic ground courses, day and night celestial navigation, and maritime navigation. Upon successful completion of advanced training, flight officers



are designated as NFOs and proceed to fleet readiness training.

## **B. OBJECTIVE**

The purpose of this research is to identify and examine variables associated with midshipmen in the service selection process at the Naval Academy to determine those variables which predict completion of flight officer training. This research attempts to provide information concerning the significance of personal data, academic grades and major, and military performance as it correlates with completion of flight officer training. The effect of gender and ethnic background on the successful completion of flight training is also analyzed. This may provide additional information that can be compared to previous Academy research.

## **C. SCOPE**

This study analyzes Naval Academy graduates selected for Naval Flight Officer training. Academy graduates selected to be Marine flight officers are excluded (Marine and Navy flight officers attend the same Navy flight school). The data set for the service selection and service assignment model consists of all graduates from year groups

1997 and 1998 who select and are subsequently assigned NFO as their first or second choice. The data set for the NFO completion model consists of Academy graduates from 1990-1996. There are numerous other measures that attempt to predict completion of flight training. The Aviation Selection Test Battery (ASTB) is administered to prospective pilots and flight officers to determine one's aptitude for flying. The battery consists of five subtests: math and verbal, mechanical comprehension, aviation and nautical information, spatial apperception, and a biographical inventory. The ASTB battery was changed and implemented in Nov 1992. However, old test scores were still valid for aviation programs until November of 1996. This study incorporates year groups who took the old and new versions. Therefore, analysis of ASTB variables is excluded because of the differences in composition and scoring between old and new versions and the extreme difficulty in obtaining ASTB data.

Data for this research is provided by Institutional Research at the U.S. Naval Academy. Institutional data such as academic grades and major, military grades, MBTI type, gender, and ethnicity are merged with flight officer designation dates from the Officer Master Files (OMF) of the Bureau of Navy Personnel.

#### **D. HYPOTHESES**

This study tests the following hypotheses:

1. Gender and ethnicity among Naval Academy graduates are not statistically significant predictors of NFO selection, assignment, or completing flight officer training.
2. A technical major from the Naval Academy is more predictive of NFO assignment than a non-technical major.
3. A technical major from the Naval Academy is no more predictive of NFO selection and completing flight officer training than a non-technical major.
4. Higher academic and military performance grades (among Academy graduates) are not statistically significant predictors of NFO selection, assignment, or completing flight officer training.
5. MBTI types who are more inclined towards practical application and achievement are more likely to complete flight officer training than those who favor abstract theory and logical reasoning.

#### **E. ORGANIZATION**

Following the introduction, Chapter II reviews literature that has used academic performance and

psychological profiles to select aviators and predict completion rates during flight training. Chapter III discusses data methodology, the dependent and independent variables, and specification of the multivariate model. Chapter IV addresses the results of the multivariate model, the significance of each variable, and the correlation of the actual results to the hypothesized results. Chapter V presents the conclusions, strengths and weaknesses of the study, and provides recommendations for future research.

## **II. LITERATURE REVIEW**

### **A. NAVAL FLIGHT OFFICER TRAINING REVIEW**

In 1974, the Naval Flight Officer basic training course underwent an analysis and revision by Human Resources Research Organization (HumRRO). The purpose was to increase the effectiveness of basic or primary NFO training by assuring that NFO basic training incorporated all the stated performance objectives. It also assessed unnecessary objectives that were then eliminated. The review process included fleet representatives from the Chief of Naval Education and Training (CNET), Chief of Naval Air Training (CNATRA), and personnel from the NFO training wing, in particular the instructors of the NFO basic training squadron, VT- 10 (Corley, Jividen, Bradley, & Siskel, 1976, p. I-2).

The review process in 1974 marked an important change in the approach to training flight officers. This shift was a move away from teaching theory and "how the system operates" to teaching the student flight officer "how to operate the system." This new learning paradigm arose from the reassessment of the NFO community. The NFO role was evolving toward one of greater importance and responsibility (p. I-3). After the review by HumRRO and the Navy, a number of objectives were deleted from the NFO basic training

syllabus. Most of the objectives dropped related to material dealing with basic electricity or other material that the fleet determined had little or no relevance to what NFOs do operationally (p. I-5). These types of objectives were removed because of its non-relevance to current NFO jobs, equipment, or operations (p. I-5).

Upon reviewing the NFO basic training program objectives, the great majority of objectives relate to performing tasks that occur in the aircraft or that are related to mission accomplishment involving the aircraft (p. I-10). Some objectives require cognitive tasks, e.g., performing flight planning. Other objectives require motor skills, e.g., operating radar controls (p. I-10). The point is that the emphasis on flight officer training is on demonstrating competence by doing, and very little emphasis is placed on talking about doing (p. I-10). This suggests that a flight officer have traits characteristic of practical ability and doing through action. There may be less interest in abstract theory and solving problems by slow, logical analysis.

Other elements of the training objectives are 'enabling' objectives, which are supporting skills and knowledge required by the student NFO (SNFO) to perform and accomplish the overall objective (p. I-12). HumRRO stated

that the SNFO already enters flight training with many of the skills and knowledge required of the enabling objectives, e.g., basic math skills of addition, subtraction, multiplication, and division (p. I-13). The other required skills can only be taught during basic ground school, e.g., computing ground speed, airspeed, altitude, and wind vector relationships. This suggests that only basic math skills are required by the SNFO and the selection process determines if the prospective flight officer applicant possesses these basic math skills. Specific flight officer skills and knowledge are taught when the individual enters flight training.

One of the benefits of the review was that the level of detail at which certain material was taught was reduced (p. I-15). The review of NFO basic training resulted in the instruction on internal design and theory of operation of various aircraft instruments and systems and the theory of various physical phenomena being de-emphasized (p. III-1). Much of the more detailed material in these areas was eliminated.

#### **B. AFFECTS OF COLLEGE MAJOR AND GPA DURING FLIGHT TRAINING**

A study by Annette Baisden (1980) compared college performance as a function of ethnic background between

African-American and white student NFOs. The largest academic major among these NFOs was in the social sciences followed by business administration and then the natural and physical sciences (p. 14). It is interesting that more liberal arts majors were selected among both African-Americans and whites for flight officer training than those with a technical background.

#### **1. GPA as a Predictor of Completion During Aviation Indoctrination**

An analysis of college GPA and academic grades received during aviation indoctrination and basic/advanced ground school during flight training was also conducted (Baisden, 1980). There was no significant correlation between college GPA and academic grades during flight training. However, for white students, GPA was significantly correlated with aviation indoctrination and basic (primary) ground school grades (p. 14). Baisden cautions the reader as to the interpretation of the results, since GPA was not controlled for the quality of college attended or college major. In addition, Baisden analyzed the GPA of African-Americans and whites who completed and attrited. The study found that there were no significant differences in GPA between completion of flight officer training and attrition for either black or white students (p. 14).



## **2. The Academic Potential of Flight Officers**

Patricia Byrnes (1989) conducted a study of success rates in naval aviation training in 1989. The analysis utilized academic qualification test (AQT) and flight aptitude rating (FAR) scores. The AQT is used to measure the academic potential of prospective pilots and flight officers. The FAR is a composite of sub-tests measuring mechanical comprehension, spatial apperception, and a biographical (personality) inventory (p.11). Note that this was the test utilized at the time of her study (1989). The AQT and FAR has since undergone revision. For Naval Flight Officers, motivational problems were the primary reasons for not completing flight training throughout the pipeline (primary, intermediate, and advanced). The second largest contributor to attrition was flight failures. Byrnes found that very few students failed for academic reasons.

However, Byrnes' (1989) report found that above average (greater than 5 on a scale of 3-9) AQT and FAR scores for flight officers were significant predictors of completing flight training (p.29). This general statement appears to be correct. Byrnes' study found that a one-unit increase in AQT/FAR score had a statistically significant (at the .05 level) effect on predicted pass rates (p.29). This suggests

that the higher ones AQT or FAR score, the greater the likelihood of completing flight training. Byrnes (p. 26) shows the percentage of students who completed flight training as a function of AQT score. Upon review of the table, flight officers who scored a 3 (lowest score considered for selection into flight officer training) on the AQT, had a higher percentage completing flight training than those who scored a 4 on the AQT. Furthermore, it appears that the completion rates of those students who scored a 3, 5, and 8 were roughly the same (about 85%). Only those students who scored a 6, 7, or 9 on the AQT had higher completion percentages (between 90% and 92%). This seems to suggest an inconclusive interpretation with regard to the relationship between AQT score and the completion of flight training. Average to below average AQT scores (3 and 5) had roughly the same completion percentages of students with an academic score of 8.

Another finding by Byrnes was a comparison of academic scores in each phase of flight officer training. For students who pass a phase, those with higher AQT (greater than 5) scores do not, on average, have higher academic performance scores than those with a low (less than 5) AQT score (Byrnes, 1989, p. 35).

Analysis of AQT scores is not part of the scope of this study because this data is extremely difficult to obtain and also because of the difficulties associated with comparing scores between the old and revised test. However, the Byrnes study does address scores or grades (AQT/FAR) as a measurement of performance and completion of flight training. The hypothesis made in this study, for Naval Academy graduates who are selected for flight officer training, is that a higher academic GPA from the Academy (prior to entering flight school) is not predictive of academic performance and completion of flight training. This hypothesis is similar to the Byrnes' conclusion that higher AQT scores for flight officers are not predictors of higher academic performance between primary, intermediate, and advanced stages of training.

#### **C. AFFECTS OF GENDER ON COMPLETION RATES**

Completion rates of women in flight training have been studied since women entered into naval aviation as flight officers in 1979 (Baisden, 1992, p. 217). Military leaders have questioned whether women were qualified for flight training and, more specifically, to fly in combat aircraft. Congress has debated whether women aviators have received fair treatment in training (Baisden, 1992, p.217). Baisden

conducted research of 421 women and 13,755 men who entered naval aviation from 1984-1991 to determine performance between men and women during flight training and whether women received fair treatment during flight training. The performance variables were Academic Qualification Test (AQT), Flight Aptitude Rating (FAR), academic grades, peer ratings, instructor evaluations, and final grades in pre-flight training, and attrition statistics. The analysis found that women achieved higher scores on the AQT while men achieved higher scores on the FAR. Both differences in test scores were statistically significant ( $p < .001$ , p. 218). Since women scored higher on the AQT, it was expected that women would have higher completion rates in pre-flight training over men. A test performed on attrition rates during pre-flight training did not show the effect to be statistically significant. Attrition rates for women were 17% and for men 18.4% (p. 219). Baisden also performed tests comparing the means of pre-flight training grades and found the grades of men were significantly higher than those of women, perhaps providing some evidence of institutional bias against women. The study was an analysis of women flight officers between 1984 and 1991 (p. 218), which was a time when women may not have been enthusiastically accepted into military aviation. A failure to accept women as equals and

to understand the learning differences between genders could also have affected women's grades since aviation has always been a male dominated culture. Kirkland (1978) reported that females are more reactive to criticism during the learning process (Baisden, p. 219). Even though men and women may learn and accept criticism differently, the possibility of institutional bias against women cannot be ruled out since the acceptance of women in aviation was in question at the time of the study. Negative stereotypes against women regarding performance in flying, especially combat aircraft leads to unfair treatment during flight training. As a result women appear to have lower performance grades even if attrition rates are not statistical significant. Institutional bias in flight training deserves further study but is beyond the scope of this research.

#### **D. ACADEMIC MAJOR AND SERVICE SELECTION AT USNA**

Academic major selection at the Naval Academy is unique in that students do not ultimately decide which major they will pursue. Midshipmen submit a list of choices but the Academic Dean makes the final decision based on the individual's preference, availability of the major, and the needs of the Navy (U.S. Naval Academy, 1997). In practice however, most midshipmen end up with the major selected. A

study by Brian Arcement (1998) analyzed the relationship between academic major at the Naval Academy and warfare community selection. Majors at the Naval Academy are grouped into three categories: 1. group one - engineering disciplines (aerospace, electrical, mechanical, and systems), 2. group two - chemistry, computer science, oceanography, general science, math, and physics, and 3. group three - economics, english, history, and political science. Service selection at the Naval Academy is dependent on five factors:

"1. personal preference, 2. cumulative academic quality point rating. AQPR is equivalent to the grade point average system (GPA) found in most university systems, 3. cumulative military quality point rating (MQPR). MQPR is a composite score of physical education, athletic performance, military performance, military conduct, and grades from professional development courses, 4. a personal interview with a board of three to five officers who make their recommendation to the Service Selection Committee, and 5. the Service Selection Committee who reviews a midshipman's preference and performance and the recommendations from the interview board (Arcement, p. 10-11)."

Arcement's analysis led to the conclusion that a shift from a group one major (engineering) to either a group two or three major was associated with a decrease in the likelihood of aviation being the first choice received (Arcement, 1998, p. 58). The analysis does not attempt to determine why these shifts are significant but it

demonstrates that changing academic major affects the likelihood that a midshipman will be assigned to a particular warfare community. This begs the question. Are midshipmen selected for specific warfare communities based on having selected a group one, two, or three major? If college major is found to be statistically insignificant in the NFO completion model, then the emphasis on a technical major for aviation selection, as Arcement's study showed, should be reviewed.

#### **E. PERSONALITY AND FLIGHT TRAINING**

In the literature, there is extensive research studying the relationship between personality, college major, and occupational choice. The studies show that people are more productive and flourish in their work environment more effectively when there is a good fit between their personality and the characteristics of their work environment (Holland, 1996). Conversely, a bad fit between personality and a person's career leads to poor performance and dissatisfaction.

The Myers-Briggs Type Indicator (MBTI) is one of many popular tests used to determine personality types and is administered to incoming midshipmen at the Naval Academy. There are eight MBTI preferences: extraversion,

introversion, sensing, intuition, thinking, feeling, judging, and perceiving (Myers-Briggs, & McCaulley 1989). The eight preferences are categorized into four groups: 1. Where do you focus your attention? 'Extraversion' - focuses on outer world and external events or 'introversion' - focuses on inner world and experiences, 2. How do you take in information? 'Sensing' - observant of what is going on around them and good at recognizing the practical realities of a situation or 'intuition' - able to grasp patterns and are especially good at seeing new possibilities and different ways of doing things, 3. How do you make decisions? 'thinking' - figuring out what is wrong with something so they can apply their problem-solving abilities, or 'feeling' - understanding and appreciating others and assessing the impact of a situation on people, and 4. How do you orient toward the outer world? 'Judging' - people who live a structured and organized lifestyle or 'perceiving' - people who live in a spontaneous, casual, and flexible way (Briggs-Myers, & McCaulley).



## **1. MBTI Types Among Academy Midshipmen**

Roush (1989) found that the Naval Academy was an ESTJ institution because these personality types like to organize and run activities and are decisive people (Arcement, 1998, p.17). This seems to be typical of military operations and suggests that an ESTJ may self-select the military lifestyle for these reasons. The most likely midshipmen in the class of 1991 to leave the Academy before graduation were INFJ, INFP, ISFP, and ENFP. In 1992, ESFJ and ENFP were most likely to leave. Roush found that the most likely types to stay were ESTJ (Roush, 1989).

## **2. Successful MBTI Types in Flight Officer Training**

One of the purposes of this study is to analyze MBTI types with completion rates to determine if a correlation exists between personality and completing flight training. This research hypothesizes that extraverts and those who are present-oriented and value practical application (sensing) are more likely to complete flight training than introverts and those who value abstract and theoretical concepts (intuition). Furthermore, thinkers are more likely to complete flight training than those who are more compassionate and accepting of people (feeling). People who are organized and structured (judging) will have higher

completion rates than those who are spontaneous and casual (perceiving).

Aviators are in general more extraverted and flying requires a pilot or flight officer to be aggressive when flying and interact with other crewmembers. Flight officers in particular, since they always fly with at least one other aviator, need to be able to communicate openly (extraversion) vice being private and closed (introversion). Flying is learned best through practical application and concrete, detailed experiences (sensing) rather than through abstract and theoretical experiences (intuition) (Briggs-Myers, 1989). An aviator must worry about the realities of a situation in the aircraft, and not think imaginatively or reflect on the situation. Aviators must think objectively to analyze (thinking) the cause and effect of a particular situation instead of assessing the impact of a decision on people (feeling). Finally, aviators must be organized (judging) when flying and be able to stick to a plan or schedule more so than feeling constrained by having to make decisions (perceiving). Although being organized and methodical are characteristics of most good aviators, an aviator who is flexible and adaptable (perceiving) in a situation is more likely to handle a bad (combat) or non-standard (aircraft emergency) event better than the judging

type. In summary, one might hypothesize that an ESTJ and to a lesser degree an ESTP has a higher probability of completing flight training than other MBTI types.

The literature review highlights studies that have attempted to link academic major and performance and personality with completion rates during flight training. Chapter III begins with a discussion of the data set and a preliminary analysis of the variables followed by Chapter IV, which presents the results of the regression analysis.

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### III. DATA ANALYSIS

#### A. BACKGROUND

The data set for the service selection and service assignment models contains 357 cases of midshipmen (mids) who select NFO as their first or second choice from year groups 1997 and 1998 and 161 observations who are assigned NFO as their first or second choice. The table below shows that 170 midshipmen select NFO as their first choice but only 156 are assigned NFO. There are 187 midshipmen who select NFO as their second choice but only five are assigned NFO.

	Selected NFO	Assigned NFO
Selected NFO first	170	156
Selected NFO second	187	5
Other	1471	1667
Total	1828	1828

The reason for the low count is that most mids receive NFO as their first choice. Of the 357 mids who select NFO first or second, only 24 are not assigned NFO. Lastly, of the 187 mids who select NFO second, 172 (91.9%) of them receive their first choice (other than NFO). Therefore, in this group, only ten receive neither their first choice nor NFO.

The data set for the NFO completion model contains a sample of 457 Naval Academy midshipmen from 1992 through 1996 who were selected to become Naval Flight Officers. The following table shows the number of those midshipmen who were designated as NFO and those that were not.

	Frequency	Percent
Designated NFO	337	73.7%
Not designated NFO	120	26.3%

Data was obtained from the Office of Institutional Research at the Naval Academy. NFO designation dates from the Bureau of Navy Personnel (BUPERS) Officer Master Files (OMF) were obtained through Institutional research to create a variable that shows whether or not a student flight officer completed flight training.

## **B. VARIABLES**

The database from the merged files includes the following variables: midshipmen identification number, NFO designation, cumulative academic and military quality point rating, academic and military orders of merit, academic major, gender, race, and a Myers Briggs Type Indicator (MBTI) score. In many cases there are qualitative choices available, and these are coded as dummy variables (0,1).

This study utilizes a binomial logit model with each dummy variable equaling one only when that particular alternative is chosen (Studenmund, p. 517). Dummy variables take on the values one or zero depending on whether some condition does or does not hold (Studenmund, 1997, p. 82). A detailed explanation of each 0/1 value for each dependent variable is provided in tables 3-1, 3-2, and 3-3.

### **1. Dependent Variables**

This study attempts to test three models. The first model explains movements in the dependent variable 'MIDN1' as a function of the independent variables. MIDN1 is assigned a value of 0 for all selections other than NFO. MIDN1 is assigned a value of 1 for those midshipmen who select NFO as their first or second choice (table 3-1). Although midshipmen are allowed to submit six choices, only the first and second choices are incorporated since 91.8% of graduates who select NFO as their first choice are assigned their first choice.

**Table 3-1            Dependent Variable: MIDN1 Model**

<b>Variable</b>	<b>Definition</b>
MIDN1	1 if selected NFO as first or second choice, 0 if service selection other than NFO

The second model explains movements in the dependent variable 'MIDN2' (table 3-2). Those mids who selected NFO second, but received their non-NFO first choice are eliminated from consideration.

**Table 3-2                      Dependent Variable: MIDN2 Model**

<b>Variable</b>	<b>Description</b>
MIDN2	1 if selected and assigned NFO as first or second choice, 0 if selected but not assigned NFO as first or second choice

After eliminating these data points, MIDN2 is assigned a value of 1 for those midshipmen who are assigned NFO as their first or second choice. MIDN2 is assigned a value of 0 for those mids who do not receive their first or second choice. The goal of the second model is to identify those midshipmen who select but do not receive NFO as their first or second choice and compare their background to those mids who are assigned NFO first or second.

The last model is the 'NFO' completion model. 'NFO' is assigned a value of zero for those student flight officers who do not complete flight training and a value of one for students who are designated an NFO (table 3-3).

**Table 3-3                      Dependent Variable: NFO Completion Model**

<b>Variable</b>	<b>Description</b>
NFO	Naval Flight Officer; 1 if designated NFO, 0 if not designated NFO



It should be noted that data explaining the reasons for not completing flight training were not available. Students do not complete because of academic and flight failures, medical disqualification (not physically, mentally, or aeronautically adaptable), and drop on request.

## **2. Independent Variables**

The independent variables that are selected for the three models are chosen based on previous studies that attempt to predict the effect of academic, military, and biographical determinants on flight training completion rates. Gender and ethnicity are also included since most studies in this field of research attempt to determine significance among males/females and between different ethnic backgrounds. For regression analysis, the categorical variables are changed to dummy variables (0,1) so that they can be quantified. Table 3-4 provides a detailed description of each independent variable.

For the MIDN1 and MIDN2 models, academic majors are consolidated into the three classifications used by the Naval Academy: group 1, group 2, and group 3. Academic order of merit (aoom) and military order of merit (moom) are divided into three groups: top third class standing, middle third, and lower third.

For the NFO completion model, the quantifiable variables *caqpr* and *cmqpr*, representing cumulative academic quality point rating and cumulative military quality point rating, are consolidated into four and three groups respectively to determine any significance among a range of quality point ratings, e.g., 2.0 - 2.49. The 16 MBTI personalities (see p. 20 for detailed characteristics) are consolidated into four main groups (table 3-4).

**Table 3-4 Independent Variables**

Variable	Definition
ethnic	1 = af, 2 = as, 3 = ca, 4 = fi, 5 = hi, 6 = na, 7 = pu
race	1 if Caucasian, 0 if other
af	African-American, 1 if af, 0 if other
as	Asian-American, 1 if as, 0 if other
ca	Caucasian, 1 if ca, 0 if other
hi	Hispanic, 1 if hi, 0 if other
ce	combined ethnicity: Filipino (fi), Native American (na), and Puerto Rican (pu). 1 if ce, 0 if other
gender	1 if female, 0 if male
aoom	academic order of merit (academic class rank) aoom1 = 1 - 323, aoom2 = 324 - 646, aoom3 = 647 - 980 where 1 = highest rank, 980 = lowest rank
aoom1	1 if 1 - 323, 0 if other
aoom2	1 if 324 - 646, 0 if other
aoom3	1 if 647 - 980, 0 if other
caqpr	cumulative academic point rating. Equivalent to the grade point average system (GPA) on a scale of 0.00 to 4.00. Includes only academic courses; caqpr1 = 2.00 - 2.49, caqpr2 = 2.50 - 2.99, caqpr3 = 3.00 - 3.49, caqpr4 = 3.50 - 4.00
caqpr1	1 if caqpr 2.00 - 2.49, 0 if other
caqpr2	1 if caqpr 2.50 - 2.99, 0 if other
caqpr3	1 if caqpr 3.00 - 3.49, 0 if other
caqpr4	1 if caqpr 3.50 - 4.00, 0 if other

Table 3-4 cont.

moom	military order of merit (military class rank) moom1 = 1 - 323, moom2 = 324 - 646, moom3 = 647 - 980 where 1 = highest rank, 980 = lowest rank
moom1	1 if 1 - 323, 0 if other
moom2	1 if 324 - 646, 0 if other
moom3	1 if 647 - 980, 0 if other
cmqpr	Cumulative military point rating. MQPR is a combination of grades on a scale of 0.00 - 4.00 in the following disciplines: physical education, athletic performance, military performance, military conduct, and professional development grades. cmqpr1 = 2.50 - 2.99, cmqpr2 = 3.00 - 3.49, cmqpr3 = 3.50 - 4.00
cmqpr1	1 if cmqpr 2.50 - 2.99, 0 if other
cmqpr2	1 if cmqpr 3.00 - 3.49, 0 if other
cmqpr3	1 if cmqpr 3.50 - 4.00, 0 if other
major	1 = group1, 2 = group2, 3 = group3
group1	Engineering majors: aerospace (EAS), electrical (EEE), mechanical (EME), systems (ENA), general (EGE), marine (ESP), ocean (EOE), and naval architecture (ESE). 1 if group1, 0 if other
group2	Chemistry (SCH), computer science (SCS), oceanography (SOC), general science (SGS), mathematics (SMA), and physics (SPH). 1 if group2, 0 if other
group3	Economics (FEC), english (HEG), history (HHS), and political science (FPSH). 1 if group3, 0 if other
mbti	1 = enmbti, 2 = esmbti, 3 = inmbti, 4 = ismbti
enmbti	Extravert / intuitive type; 1 if enmbti, 0 if other
esmbti	Extravert / sensing type; 1 if esmbti, 0 if other
inmbti	Introvert / intuitive type; 1 if inmbti, 0 if other
ismbti	Introvert / sensing type; 1 if ismbti, 0 if other

### C. MODEL SPECIFICATION

Based on the previous literature review, this study attempts to test the hypothesis (for models MIDN1 and MIDN2) that academic and military orders of merit do not significantly predict NFO service selection and service assignment. Another hypothesis tested is whether college major can significantly predict NFO service assignment. For the NFO completion model, the hypothesis tested is whether

college major and quality point ratings are statistically significant in predicting NFO completion rates.

### 1. MIDN1 and MIDN2 Models

The analysis of the first and second model is based on a multivariate statistical model where:

$$\begin{aligned} \text{Likelihood of } Y \text{ (MIDN1)} = & \text{constant} + \beta_1 \text{ gender} + \\ & \beta_2 \text{ group1} + \beta_3 \text{ group2} + \beta_4 \text{ group3} + \beta_5 \text{ aoom1} \beta_6 \text{ aoom2} + \\ & \beta_7 \text{ aoom3} + \beta_8 \text{ moom1} + \beta_9 \text{ moom2} + \beta_{10} \text{ moom3} \end{aligned}$$

$$\begin{aligned} \text{Likelihood of } Y \text{ (MIDN2)} = & \text{constant} + \beta_1 \text{ gender} + \\ & \beta_2 \text{ group1} + \beta_3 \text{ group2} + \beta_4 \text{ group3} + \beta_5 \text{ aoom1} \beta_6 \text{ aoom2} + \\ & \beta_7 \text{ aoom3} + \beta_8 \text{ moom1} + \beta_9 \text{ moom2} + \beta_{10} \text{ moom3} \end{aligned}$$

The multivariate coefficients,  $\beta$ , isolate the impact on (Y) of a change in one independent variable from the impact of changes in the other independent variables. This allows for the ability to measure the impact of one variable on the dependent variable holding constant the influence of other variables in the equation (Studenmund, 1997, p.15).

The first model determines if midshipmen, who select NFO as their first or second choice, can be identified by major, academic, or military order of merit. For example, do only the highest ranking midshipmen select NFO as their first or

second choice or is there no correlation to aoom and moom and selecting NFO.

The justification for the second model, MIDN2, is to determine whether major, academic and military order of merit can predict those midshipmen who select and are assigned NFO as their first or second choice and those who do not receive their first or second choice. Does a change from a group 1 major (engineering) reduce the likelihood of being selected for NFO? If any of the independent variables are significant predictors of service selection or service assignment, then the goal is to determine if those same variables are significant predictors of NFO completion.

The expected signs for the MIDN1 and MIDN2 models show a positive or negative impact on service selection where a positive (+) sign increases the likelihood of receiving first choice in service assignment. The expected signs for this model are gender (+), group1 (+), group2 (-), group3 (-), aoom1 (+), aoom2 (+), aoom3 (+), moom1 (+), moom2 (+), moom3 (+).

## 2. NFO Completion Model

The analysis of the third model is based on a multivariate statistical model where:

$$\begin{aligned} \text{Likelihood NFO completed flight training} = & \text{constant} + \\ & \beta_1 \text{ gender} + \beta_2 \text{ race} + \beta_3 \text{ group1} + \beta_4 \text{ group2} + \beta_5 \text{ group3} \\ & + \beta_6 \text{ caqpr1} + \beta_7 \text{ caqpr2} + \beta_8 \text{ caqpr3} + \beta_9 \text{ cmqpr1} + \\ & \beta_{10} \text{ cmqpr2} + \beta_{11} \text{ cmqpr3} + \beta_{12} \text{ enmbti} + \beta_{13} \text{ esmbti} + \\ & \beta_{14} \text{ inmbti} + \beta_{15} \text{ ismbti} \end{aligned}$$

The justification for the third model is based on previous studies in which differences in completion rates during flight training were related to factors such as gender, ethnicity, academic performance, and major.

The expected signs for the coefficients in the NFO completion must be hypothesized. A positive (+) sign means the variable increases the likelihood of completing NFO training. A negative (-) sign reduces the likelihood of completing training. The expected signs are as follows: gender (+), race (+), group1 (+), group2 (+), group3 (+), aoom1 (+), aoom2 (+), aoom3 (+), moom1 (+), moom2 (+), moom3 (+), esmbti (+), enmbti (-), ismbti (-), inmbti (-).

#### **D. HYPOTHESIS SPECIFICATION**

The hypothesis that will be tested in the MIDN1 model is whether any of the independent variables can significantly predict NFO selection. The MIDN2 model will analyze the impact the specified independent variables have on receiving first or second choice. The third model determines the significance of the relevant independent variables on completion of NFO flight training. The reference variables selected represent the highest mean or greatest number of cases for that category, e.g. group 1, 2, or 3. See the descriptive statistics table in Appendixes B, C, and D for summary of this data.

Since logit regression is used in this study, the computed chi-square determines the overall fit of the model or significance as a whole, in a manner similar to the F-test in linear regression.

The effects of the independent variables are measured through analysis of the logistic regression equation results. A test for significance of each independent variable is based on the Wald statistic to determine which variables are significant predictors of service selection, service assignment, and NFO completion. The decision rule used to reject or accept the null hypothesis ( $H_0$ ) will be the chi-square test for the model and the Wald statistic for

each independent coefficient. The overall model and each independent coefficient are tested to the 5% level of significance.

The hypotheses for the coefficients of the MIDN1 model are:

$$H_0: \beta_1 \text{ gender} = 0; \beta_2 \text{ group2} = 0; \beta_3 \text{ group3} = 0;$$

$$\beta_4 \text{ aoom1} = 0; \beta_5 \text{ aoom3} = 0; \beta_6 \text{ moom1} = 0; \beta_7 \text{ moom3} = 0$$

$H_A$ :  $H_0$  is not equal to zero for each independent variable

Reference variables: group1, aoom2, and moom2

The hypotheses for the coefficients of the MIDN2 model are:

$$H_0: \beta_1 \text{ gender} = 0; \beta_2 \text{ group2} = 0; \beta_3 \text{ group3} = 0;$$

$$\beta_4 \text{ aoom2} = 0; \beta_5 \text{ aoom3} = 0; \beta_6 \text{ moom2} = 0; \beta_7 \text{ moom3} = 0$$

$H_A$ :  $H_0$  is not equal to zero for each independent variable

Reference variables: group1, aoom1, and moom1



The hypotheses for the NFO completion model are:

$H_0: \beta_1 \text{ gender} = 0; \beta_2 \text{ race} = 0; \beta_3 \text{ group2} = 0;$

$\beta_4 \text{ group3} = 0; \beta_5 \text{ caqpr1} = 0; \beta_6 \text{ caqpr3} = 0;$

$\beta_7 \text{ cmqpr1} = 0; \beta_8 \text{ cmqpr3} = 0; \beta_9 \text{ esmbti} = 0;$

$\beta_{10} \text{ ismbti} = 0; \beta_{11} \text{ inmbti} = 0$

$H_A: H_0$  is not equal to zero for each independent variable

Reference variables: group1, caqpr2, cmqpr2, and enmbti

#### **E. PRELIMINARY ANALYSIS: MIDN1 MODEL**

The data set consists of 1,836 observations from year groups 1997 and 1998, which includes service selection and assignments for all warfare communities. Eight cases contain missing information and were deleted to arrive at a final data set of 1828 cases. Referencing the frequency table MIDN1 in Appendix B, 357 or 19.5% of Academy graduates select NFO as their first or second choice. Males comprise 1582 or 86.5% of the observations compared with females who number 246 or 13.5% of the total.

1. Means: MIDN1 Model

Table 3-4 Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
MIDN1	1828	.00	1.00	.1953	.3965
Gender	1828	0	1	.13	.34
Major	1828	1.00	3.00	1.9765	.8666
GROUP1	1828	.00	1.00	.3873	.4873
GROUP2	1828	.00	1.00	.2489	.4325
GROUP3	1828	.00	1.00	.3638	.4812
AOOM1	1828	.00	1.00	.3425	.4747
AOOM2	1828	.00	1.00	.3463	.4759
AOOM3	1828	.00	1.00	.3113	.4631
MOOM1	1828	.00	1.00	.3452	.4756
MOOM2	1828	.00	1.00	.3496	.4770
MOOM3	1828	.00	1.00	.3053	.4606
Valid N (listwise)	1828				

Table 3-4 provides means (or proportions) for the variables used in the regression analysis. Refer to the discussion on independent variables p. 29 - 31 or Appendix A for the coding of variables. Out of the entire population of 1828, 19.5% (.1953) of midshipmen select NFO as their first or second choice. A higher proportion (.3873) of midshipmen who select NFO as their first or second choice are engineering or group1 majors, followed by humanities and social sciences or group3 majors (.3638); and lastly, math and science or group2 majors (.2489). A higher proportion of midshipmen who select and receive NFO as their service assignment are ranked in the middle third of their class academically (aoom2) and militarily (moom2).

## 2. Crosstabulations: MIDN1 Model

The results of the major\*MIDN1\*gender crosstabulation (table 3-5) show the percentage of males and females, by major, who select NFO as their first or second choice.

**Table 3-5 Major \* MIDN1 \* Gender Crosstabulation**

				MIDN1		Total
Gender				others	ssNF01/2	
male	Major	group1	Count	506	133	639
			% within Major	79.2%	20.8%	100.0%
		group2	Count	301	74	375
			% within Major	80.3%	19.7%	100.0%
		group3	Count	458	110	568
			% within Major	80.6%	19.4%	100.0%
	Total		Count	1265	317	1582
			% within Major	80.0%	20.0%	100.0%
female	Major	group1	Count	55	14	69
			% within Major	79.7%	20.3%	100.0%
		group2	Count	67	13	80
			% within Major	83.8%	16.3%	100.0%
		group3	Count	84	13	97
			% within Major	86.6%	13.4%	100.0%
	Total		Count	206	40	246
			% within Major	83.7%	16.3%	100.0%

Roughly the same percentage of males from each group major (20.8%, 19.7%, and 19.4%) select NFO as their first or second choice. More females (20.3%) from group1 majors select NFO than the other group majors, but the number of observations for females is small (n=40), so that a small change in the number of females who select NFO between the groups has a noticeable affect on the percentages.

Table 3-6 shows the breakdown of service selection as a function of academic order of merit (aoom). The distribution of service selection is also approximately the same (19.6%, 20.9%, 19.5%) across academic order of merit. More females from the top third (23.7%) of their class select NFO than the middle or bottom third. Again the numbers for females are low.

**Table 3-6 AOOM \* MIDN1 \* Gender Crosstabulation**

				MIDN1		Total
Gender				others	ssNFO1/2	
male	AOOM	aoom1	Count	442	108	550
			% within AOOM	80.4%	19.6%	100.0%
		aoom2	Count	423	112	535
			% within AOOM	79.1%	20.9%	100.0%
		aoom3	Count	400	97	497
			% within AOOM	80.5%	19.5%	100.0%
	Total		Count	1265	317	1582
			% within AOOM	80.0%	20.0%	100.0%
female	AOOM	aoom1	Count	58	18	76
			% within AOOM	76.3%	23.7%	100.0%
		aoom2	Count	86	12	98
			% within AOOM	87.8%	12.2%	100.0%
		aoom3	Count	62	10	72
			% within AOOM	86.1%	13.9%	100.0%
	Total		Count	206	40	246
			% within AOOM	83.7%	16.3%	100.0%

The same relationship holds true for military order of merit (table 3-7). About the same percentage of midshipmen (~20%) in all military order of merit groups select NFO as their first or second choice.

**Table 3-7 MOOM \* MIDN1 \* Gender Crosstabulation**

				MIDN1		Total
Gender				others	ssNFO1/2	
male	MOOM	moom1	Count	442	111	553
			% within MOOM	79.9%	20.1%	100.0%
		moom2	Count	427	108	535
			% within MOOM	79.8%	20.2%	100.0%
		moom3	Count	396	98	494
			% within MOOM	80.2%	19.8%	100.0%
	Total		Count	1265	317	1582
			% within MOOM	80.0%	20.0%	100.0%
female	MOOM	moom1	Count	62	16	78
			% within MOOM	79.5%	20.5%	100.0%
		moom2	Count	90	14	104
			% within MOOM	86.5%	13.5%	100.0%
		moom3	Count	54	10	64
			% within MOOM	84.4%	15.6%	100.0%
	Total		Count	206	40	246
			% within MOOM	83.7%	16.3%	100.0%

As with academic order of merit, the top third of the females in military ranking are more likely to select NFO as first or second choice.

**F. PRELIMINARY ANALYSIS: MIDN2 MODEL**

The raw data set consists of 1,836 observations from year groups 1997 and 1998, which includes service selection and assignments for all warfare communities. Eight cases contain missing information and are deleted. The objective of the second model is to isolate those mids who select and are assigned NFO as their first or second choice and those mids who select NFO first or second but are not assigned NFO. Cases in which first choice other than NFO is assigned

are deleted. The final set consists of 185 cases.

Referencing the frequency table MIDN2 in Appendix C, 161 or 87.0% of Academy midshipmen select and are assigned NFO as their first or second choice. The table also shows that only 13.0% of mids who select NFO first or second are not assigned NFO. Males comprise 165 or 89.2% of the observations compared to females who number 20 or 10.8%.

Referencing table 3-8, males are the predominant gender at the Academy where males=0 and females=1.

#### 1. Means: MIDN2 Model

**Table 3-8 Descriptive Statistics**

	N	Minimum	Maximum	Mean	Std. Deviation
MIDN2	185	.00	1.00	.8703	.3369
Gender	185	0	1	.11	.31
GROUP1	185	.00	1.00	.4162	.4943
GROUP2	185	.00	1.00	.2541	.4365
GROUP3	185	.00	1.00	.3297	.4714
AOOM1	185	.00	1.00	.3514	.4787
AOOM2	185	.00	1.00	.3081	.4630
AOOM3	185	.00	1.00	.3405	.4752
MOOM1	185	.00	1.00	.3514	.4787
MOOM2	185	.00	1.00	.3081	.4630
MOOM3	185	.00	1.00	.3405	.4752
Valid N (listwise)	185				

A higher proportion (.4162) of graduates assigned NFO as their first or second choice are engineering or group1 majors, followed by humanities' or group3 majors (.3297) and

lastly, by math and science or group2 majors (.2541). This correlates with the MIDN1 model where the proportions for selection are highest for group1 majors, followed by group3, and lastly by group2 majors. The descriptive analysis suggests that major does not appear to be a significant variable for selection or assignment. Table 3-8 also shows that the greatest number of NFO assignments are given to those who are ranked in the top third of their class in academic (.3514) and military (.3514) order of merit

## **2. Crosstabulations: MIDN2 Model**

The results of the major\*MIDN2\*gender crosstabulation (table 3-9) show the percentage of males and females who are assigned NFO given that they select NFO as their first or second choice by major. As discussed above, mids who select NFO as their second choice, but receive their first choice are eliminated from the data. Roughly the same percentage of males from each group major (90.1%, 82.1%, and 87.3%) select and receive NFO as their first or second choice. The counts for those not assigned NFO as first or second choice are small (n=24), but the distribution for non-assignment among males is approximately the same for each group major. Female assignment rates are the same for group 1 and group3 majors (100%).

Table 3-9 Major \* MIDN2 \* Gender Crosstabulation

				MIDN2		Total
Gender				ssNFO1/2&notsa	ssNFO1/2&sa	
male	Major	group1	Count	7	64	71
			% within Major	9.9%	90.1%	100.0%
		group2	Count	7	32	39
			% within Major	17.9%	82.1%	100.0%
		group3	Count	7	48	55
			% within Major	12.7%	87.3%	100.0%
	Total		Count	21	144	165
			% within Major	12.7%	87.3%	100.0%
female	Major	group1	Count		6	6
			% within Major		100.0%	100.0%
		group2	Count	3	5	8
			% within Major	37.5%	62.5%	100.0%
		group3	Count		6	6
			% within Major		100.0%	100.0%
	Total		Count	3	17	20
			% within Major	15.0%	85.0%	100.0%

Table 3-10 shows the breakdown of service assignment as a function of academic order of merit (aoom). The distribution of service selection and assignment is the same for males ranked in the top and middle third academically (100%). The only male mids who are not assigned NFO first or second are those who are ranked in the bottom third of their class. The correlation for assignment is similar among females: aoom1 (100%), aoom2 (85.7%), and aoom3 (60.0%). This suggests that graduates are rewarded for academic performance, and are more likely to receive their first or second choice of NFO.



Table 3-10 AOOM \* MIDN2 \* Gender Crosstabulation

				MIDN2		Total
Gender				ssNFO1/2&notsa	ssNFO1/2&sa	
male	AOOM	aoom1	Count		57	57
			% within AOOM		100.0%	100.0%
		aoom2	Count		50	50
			% within AOOM		100.0%	100.0%
		aoom3	Count	21	37	58
			% within AOOM	36.2%	63.8%	100.0%
	Total	Count	21	144	165	
		% within AOOM	12.7%	87.3%	100.0%	
female	AOOM	aoom1	Count		8	8
			% within AOOM		100.0%	100.0%
		aoom2	Count	1	6	7
			% within AOOM	14.3%	85.7%	100.0%
		aoom3	Count	2	3	5
			% within AOOM	40.0%	60.0%	100.0%
	Total	Count	3	17	20	
		% within AOOM	15.0%	85.0%	100.0%	

The same relationship holds true for military order of merit (table 3-11). All males (except one) and female midshipmen ranked in the top and middle third of their class in military performance are assigned NFO as their first or second choice. The initial analysis suggests that academic and military performance may be significant variables.

**Table 3-11 MOOM \* MIDN2 \* Gender Crosstabulation**

				MIDN2		Total
Gender				ssNFO1/2&notsa	ssNFO1/2&sa	
male	MOOM	moom1	Count		56	56
			% within MOOM		100.0%	100.0%
		moom2	Count	1	52	53
			% within MOOM	1.9%	98.1%	100.0%
		moom3	Count	20	36	56
			% within MOOM	35.7%	64.3%	100.0%
	Total		Count	21	144	165
			% within MOOM	12.7%	87.3%	100.0%
female	MOOM	moom1	Count		9	9
			% within MOOM		100.0%	100.0%
		moom2	Count		4	4
			% within MOOM		100.0%	100.0%
		moom3	Count	3	4	7
			% within MOOM	42.9%	57.1%	100.0%
	Total		Count	3	17	20
			% within MOOM	15.0%	85.0%	100.0%

#### **G. NFO COMPLETION MODEL**

The data set consists of a sample of 457 Naval Academy graduates from year groups 1992 through 1996 who are selected for Naval Flight Officer training. As shown in Appendix D, 337 or 73.7% of Academy graduates who are selected for flight officer training complete flight school. There are 120 or 26.3% Academy graduates who do not complete. Statistics on the reasons for not completing flight training are unavailable. As indicated above students do not complete flight training for a number of reasons:

excessive academic or flight failures, not medically qualified, or drop on request. Caucasians represent the majority ethnicity at 84.5% followed by Hispanics (5.9%), Asians (4.6%), and African-Americans (3.1%). The data set also contains six (1.3%) Filipinos, one (0.2%) Native American, and two (0.4%) Puerto Ricans. Males comprise 427 observations or 93.4% of the population and females 30 observations or 6.6%.

1. Means: NFO Completion Model

Table 3-8 Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
NFO	457	0	1	.74	.44
AF	457	.00	1.00	3.063E-02	.1725
AS	457	.00	1.00	4.595E-02	.2096
CA	457	.00	1.00	.8446	.3626
HI	457	.00	1.00	5.908E-02	.2360
CE	457	.00	1.00	1.969E-02	.1391
GENDER	457	0	1	6.56E-02	.25
CAQPR1	457	.00	1.00	.1007	.3012
CAQPR2	457	.00	1.00	.4639	.4992
CAQPR3	457	.00	1.00	.3129	.4642
CAQPR4	457	.00	1.00	.1225	.3283
CMQPR1	457	.00	1.00	.1510	.3584
CMQPR2	457	.00	1.00	.6521	.4768
CMQPR3	457	.00	1.00	.1969	.3981
GROUP1	457	.00	1.00	.4333	.4961
GROUP2	457	.00	1.00	.2254	.4183
GROUP3	457	.00	1.00	.3414	.4747
ENMBTI	451	.00	1.00	.3149	.4650
ESMBTI	451	.00	1.00	.2705	.4447
INMBTI	451	.00	1.00	.1996	.4001
ISMBTI	451	.00	1.00	.2151	.4113
Valid N (listwise)	451				

Note: The notation E represents the operation of taking a numerical value to a specific power of ten, e.g., 3.063E-02 = 0.03063

Table 3-8 provides means (or proportions) for the variables used in the regression analysis. Refer to the discussion on independent variables p. 25 - 28 or Appendix A for the coding of variables. A higher proportion (.4639) of graduates selected for flight officer training have a cumulative academic point rating in the range of 2.50 - 2.99 which equates with the variable caqpr2. A higher proportion (.4333) of flight officer selectees have military scores in the range of 3.00 - 3.50. There are higher numbers of engineering majors (.2705) selected for flight officer training, followed by group3 majors (.2151). With respect to the MBTI, more flight officer selectees are extravert/intuitive (enmbti = .3149), followed by extravert/sensing (esmbti = .2705). Note that there are six cases missing for MBTI data. They are not removed from the data set because only the MBTI data is missing.

## **2. Crosstabulations: NFO Completion Model**

In performing the preliminary analysis, crosstabulations are computed to determine the associations between the dependent and independent variables and to look for patterns that may be significant to NFO completion rates. The results of ethnic\*NFO\*gender crosstabulation (table 3-9) show completion rates by gender and ethnicity.

The Caucasian (ca) group is the only ethnic group that should be considered as valid data. The population sizes for other ethnic groups are too small ( $n < 30$ ) to provide any strong conclusions. Even Caucasian females have a small count ( $n = 30$ ). Observing the two largest groups, male and female Caucasians, the completion rates are essentially the same: 75.7% for Caucasian males and 75% for Caucasian females. This preliminary analysis suggests that gender is not a significant predictor of NFO completion as hypothesized in the model specification.

Table 3-9

## ETHNIC \* NFO \* GENDER Crosstabulation

				NFO		Total	
GENDER				Not NFO	NFO		
M	ETHNIC	AF	Count	6	7	13	
			% within ETHNIC	46.2%	53.8%	100.0%	
		AS	Count	6	14	20	
			% within ETHNIC	30.0%	70.0%	100.0%	
		CA	Count	87	271	358	
			% within ETHNIC	24.3%	75.7%	100.0%	
		FI	Count	3	3	6	
			% within ETHNIC	50.0%	50.0%	100.0%	
		HI	Count	8	19	27	
			% within ETHNIC	29.6%	70.4%	100.0%	
		NA	Count		1	1	
			% within ETHNIC		100.0%	100.0%	
	PU	Count	1	1	2		
		% within ETHNIC	50.0%	50.0%	100.0%		
Total			Count	111	316	427	
			% within ETHNIC	26.0%	74.0%	100.0%	
F	ETHNIC	AF	Count	1		1	
			% within ETHNIC	100.0%		100.0%	
		AS	Count	1		1	
			% within ETHNIC	100.0%		100.0%	
		CA	Count	7	21	28	
			% within ETHNIC	25.0%	75.0%	100.0%	
	Total			Count	9	21	30
				% within ETHNIC	30.0%	70.0%	100.0%

The caqpr\*NFO\*gender crosstab (table 3-10) shows the distribution of academic quality point rating with respect to completion rates. The highest percentage completion rate for males is acqpr3 (82.4%) and includes those Academy graduates that have a grade point average of 3.00 - 3.49. This may prove to be significant in the regression analysis.

Table 3-10

## CAQPR \* NFO \* GENDER Crosstabulation

				NFO		Total	
GENDER				Not NFO	NFO		
M	CAQPR	acqpr1	Count	14	30	44	
			% within CAQPR	31.8%	68.2%	100.0%	
		acqpr2	Count	60	138	198	
			% within CAQPR	30.3%	69.7%	100.0%	
		acqpr3	Count	23	108	131	
			% within CAQPR	17.6%	82.4%	100.0%	
		acqpr4	Count	14	40	54	
			% within CAQPR	25.9%	74.1%	100.0%	
		Total		Count	111	316	427
				% within CAQPR	26.0%	74.0%	100.0%
F	CAQPR	acqpr1	Count	1	1	2	
			% within CAQPR	50.0%	50.0%	100.0%	
		acqpr2	Count	4	10	14	
			% within CAQPR	28.6%	71.4%	100.0%	
		acqpr3	Count	4	8	12	
			% within CAQPR	33.3%	66.7%	100.0%	
		acqpr4	Count		2	2	
			% within CAQPR		100.0%	100.0%	
		Total		Count	9	21	30
				% within CAQPR	30.0%	70.0%	100.0%

The percentage differences for acqpr1, 2, and 4 seem too small to be important (68.2%, 69.7%, and 74.0% respectively). For females, the highest valid completion rate (74%) is for those graduates that fell in the acqpr2 group (acqpr = 2.50 - 2.99). The variable acqpr4 had a 100% completion rate but there were only two observations. As noted before, the counts for females and ethnic groups other than Caucasian are low and the results based on low observation counts must be interpreted with caution.

A similar crosstab (table 3-11) is performed utilizing the military quality point rating. The military quality point rating is a combined score from an Academy graduate's performance in five disciplines: physical education, athletic performance, military performance, conduct, and professional development grades.

**Table 3-11 CMQPR \* NFO \* GENDER Crosstabulation**

				NFO		Total
GENDER				Not NFO	NFO	
M	CMQPR	cmqpr1	Count	28	37	65
			% within CMQPR	43.1%	56.9%	100.0%
		cmqpr2	Count	67	210	277
			% within CMQPR	24.2%	75.8%	100.0%
		cmqpr3	Count	16	69	85
			% within CMQPR	18.8%	81.2%	100.0%
	Total		Count	111	316	427
			% within CMQPR	26.0%	74.0%	100.0%
F	CMQPR	cmqpr1	Count	3	1	4
			% within CMQPR	75.0%	25.0%	100.0%
		cmqpr2	Count	4	17	21
			% within CMQPR	19.0%	81.0%	100.0%
		cmqpr3	Count	2	3	5
			% within CMQPR	40.0%	60.0%	100.0%
	Total		Count	9	21	30
			% within CMQPR	30.0%	70.0%	100.0%

A strong association seems to exist for males who complete flight officer training and cmqpr. Those male graduates with the highest military grades, cmqpr3 = 3.50 - 4.00, also had the highest percentage completion rates (81.2%). Those graduates that fell in the lowest range, cmqpr1 = 2.50 -



2.99, had the lowest percentage completion rates (25%). The variable cmqpr could prove to be significant in the regression analysis. On the other hand, females in the cmpqr2 range (3.00 - 3.49) had the highest percentage completion rates (81%).

Major\*NFO\*gender crosstabulation (table 3-12) shows the distribution of majors and NFO completion rates. Male (77.1%) and female (80%) group1 majors have higher percentages of completing flight officer training followed by group3 for males and group2 for females. Female group3 majors seem to have low completion rates (54.5%).

**Table 3-12 MAJOR \* NFO \* GENDER Crosstabulation**

				NFO		Total
GENDER				Not NFO	NFO	
M	MAJOR	group1	Count	43	145	188
			% within MAJOR	22.9%	77.1%	100.0%
		group2	Count	28	66	94
			% within MAJOR	29.8%	70.2%	100.0%
		group3	Count	40	105	145
			% within MAJOR	27.6%	72.4%	100.0%
	Total		Count	111	316	427
			% within MAJOR	26.0%	74.0%	100.0%
F	MAJOR	group1	Count	2	8	10
			% within MAJOR	20.0%	80.0%	100.0%
		group2	Count	2	7	9
			% within MAJOR	22.2%	77.8%	100.0%
		group3	Count	5	6	11
			% within MAJOR	45.5%	54.5%	100.0%
	Total		Count	9	21	30
			% within MAJOR	30.0%	70.0%	100.0%

Although the percentage rate differences are fairly small for male group 1 and 3 majors and female group 1 and 2

majors, male and female engineering majors complete at higher rates than math and science majors' (group2) and social science majors (group3).

The final crosstab performed was MBTI\*NFO\*gender (table 3-13). This crosstab counts NFO completion rates using an Academy graduates personality type (MBTI). Completion rates for males are similar for each MBTI type, ranging from 71.7% to 77.1%.

**Table 3-13      MBTI \* NFO \* GENDER Crosstabulation**

	NFO	
		Total

GENDER				Not NFO	NFO	
M	MBTI	enmbti	Count	36	91	127
			% within MBTI	28.3%	71.7%	100.0%
		esmbti	Count	27	91	118
			% within MBTI	22.9%	77.1%	100.0%
		inmbti	Count	24	63	87
			% within MBTI	27.6%	72.4%	100.0%
		ismbti	Count	23	67	90
			% within MBTI	25.6%	74.4%	100.0%
	Total		Count	110	312	422
			% within MBTI	26.1%	73.9%	100.0%
F	MBTI	enmbti	Count	5	10	15
			% within MBTI	33.3%	66.7%	100.0%
		esmbti	Count	3	1	4
			% within MBTI	75.0%	25.0%	100.0%
		inmbti	Count		3	3
			% within MBTI		100.0%	100.0%
		ismbti	Count		7	7
			% within MBTI		100.0%	100.0%
	Total		Count	8	21	29
			% within MBTI	27.6%	72.4%	100.0%

Males who are extraverted/sensing types (es) have the highest completion rates at 77.1%. Interestingly, females who are introverted, either intuitive (in) or sensing (is) have the highest completion rates. All seven ismbti and all three inmbti females completed flight training. This seems to suggest that introverted females fair better then their extraverted counterparts; the opposite of what occurred for males. Females who are esmbti types have the lowest percentage completion rate (25%). Again, one must recall that there are a small number of observations for females in the data set.

## **H. SUMMARY**

The preliminary analysis for the service selection model, MIDN1, shows a similar percentage of mids in each group major selecting NFO as a first or second choice. A similar proportion of male mids, who select NFO first or second, come from each academic (aoom) and military (moom) order of merit group. It does not appear that major, academic or military standing has a significant impact on selecting NFO first or second.

The initial analysis for the service assignment model, MIDN2, indicates that the large majority of relevant midshipmen are assigned NFO as their first or second choice. It is not anticipated that any of the explanatory variables will be significant predictors of service assignment.

The preliminary analysis appears to show mixed results when compared to the hypotheses for the NFO completion model. The mean academic quality point rating group, caqpr2, shows a narrow spread in completion percentages between males (69.7%) and females (74.1%). However, among males, the highest percentage of completions is the caqpr3 group (84.1%) and may be a significant predictor of NFO completion. Military grades may be a significant predictor of NFO completion for males, challenging the hypothesis that military grades are not significant predictors of completing

flight school. Academic major does not appear to be a significant predictor of completion since the percentage completion rates are small. One noteworthy finding is the low completion rate for female group3 majors (54.5%). Finally, although extraverted/sensing males have the highest completion rate (77.1%), the percentage spread between all male MBTI types is small. An interesting finding is that introverted females have 100% completion rates, although the number of observations is small (n=10).

Chapter four will analyze the results from the hypothesized models using logistic regression to determine if any independent variables are significant predictors of completing flight officer training or in service assignment.

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## CHAPTER IV: LOGISTIC REGRESSION ANALYSIS

Logistic regression is used to estimate the variable coefficients of the hypothesized models discussed in Chapter III. These results will then be analyzed to determine if they support the hypothesized relationships discussed in that chapter.

### A. LOGISTIC REGRESSION MODEL

Since the outcome of all models has only two outcomes, e.g., NFO completion: 1. NFO, 2. not NFO, the binomial (or binary) logit analysis is used. The binomial logit is an estimation technique for equations with dummy dependent variables by using a variant of the cumulative logistic function:

$$\ln\left(\frac{D_i}{[1-D_i]}\right) = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \epsilon_i$$

where  $D_i$  is a dummy variable, the probability that the  $i$ th person will make the choice described by  $D_i = 1$ , e.g., NFO = 1, Not NFO = 0 (Studenmund, 1997, p. 509). The equation above states that the log of odds that a choice in the dependent variable will be made is a linear function of the relevant independent variables.

## B. BINOMIAL LOGIT ESTIMATION: MIDN1 MODEL

The first model determines whether major, academic order of merit, or military order of merit can predict those Academy midshipmen who select NFO as their first or second choice.

Dependent variable: MIDN1

Independent variables: gender, group2, group3, aoom1, aoomm3, moom1, moom3

Reference variables: group1, aoom2, moom2

**Table 4-1 Variable Description for MIDN1 Model**

Variable*	Values
MIDN1	1 if selected NFO as first or second choice, 0 if selected community other than NFO
Gender	1 if female, 0 if male
group1	1 if engineering majors, 0 if other
group2	1 if math and science majors, 0 if other
group3	1 if social sciences and humanities, 0 if other
aoom1	1 if 1 - 323, 0 if other
aoom2	1 if 324 - 646, 0 if other
aoom3	1 if 647 - 980, 0 if other
moom1	1 if 1 - 323, 0 if other
moom2	1 = 324 - 646, 0 if other
moom3	1 = 647 - 980, 0 if other

\* Reference appendix A for definitions of each variable

Since logistic regression is used in this study, the decision rule used to accept or reject the null hypothesis,  $H_0$ , is via the chi-square test for the model as a whole (similar to the F-test in linear regression) and the Wald statistic for each independent coefficient. The overall



model and independent variables are tested at the 5% level of significance.

**Table 4-2**                      **Chi -square results**

<b>Chi-square</b>	3.275
<b>Df</b>	7
<b>Significance</b>	.8585

As shown in table 4-2 above, the first model is not significant at the 5% (.8585 > .05) level of significance. The model does a poor job of predicting those graduates who select NFO as their first or second choice. The null hypothesis for the overall model:

$$H_0: '1 \text{ gender} = 0; '2 \text{ group2} = 0; '3 \text{ group3} = 0;$$

$$'4 \text{ aoom1} = 0; '6 \text{ aoom3} = 0; '6 \text{ moom1} = 0; '7 \text{ moom3} = \square$$

cannot be rejected.

Viewing the column labeled 'Sig,' in table 4-3 indicates that the independent variables are not good predictors of service selection. All variables are insignificant at the 5% level ( $p > .05$ ). Therefore, the hypothesis specified before the model was estimated is

valid. None of the independent variables are significant predictors of service selection.

**Table 4-3 Variables in the Equation**

Variable	B	S.E.	Wald	df	Sig	R	Exp(B)
GENDER	-.2413	.1850	1.7020	1	.1920	.0000	.7856
GROUP2	-.0790	.1523	.2694	1	.6037	.0000	.9240
GROUP3	-.1251	.1377	.8256	1	.3636	.0000	.8824
AOOM1	.0130	.1542	.0071	1	.9330	.0000	1.0131
AOOM3	-.0594	.1615	.1351	1	.7132	.0000	.9423
MOOM1	.0302	.1540	.0386	1	.8443	.0000	1.0307
MOOM3	.0399	.1620	.0607	1	.8053	.0000	1.0407
Constant	-1.3305	.1431	86.4599	1	.0000		

Count(n) = 1828

**C. BINOMIAL LOGIT ESTIMATION: MIDN2 MODEL**

The second model goes one step further and tests the significance of major, academic and military order of merit between midshipmen who select and are assigned NFO as their first or second choice and those who select but are not assigned NFO as their first or second choice. Those who select NFO as their second choice, but receive their first choice are excluded.

Dependent variable: MIDN2

Independent variables: gender, group2, group3, aoom2, aoom3, moom2, moom3

Reference variables: group1, aoom1, moom1

**Table 4-4 Variable Description for MIDN2 Model**

Variable*	Values
MIDN2	1 if selected NFO as first or second choice and assigned NFO 0 if selected NFO as first or second choice but not assigned NFO and did not receive non-NFO first choice
Gender	1 if female, 0 if male
group1	1 if engineering majors, 0 if other
group2	1 if math and science majors, 0 if other
group3	1 if social sciences and humanities, 0 if other
aoom1	1 if 1 - 323, 0 if other
aoom2	1 if 324 - 646, 0 if other
aoom3	1 if 647 - 980, 0 if other
moom1	1 if 1 - 323, 0 if other
moom2	1 = 324 - 646, 0 if other
moom3	1 = 647 - 980, 0 if other

\* Reference appendix A for definitions of each variable

**Table 4-5 Chi-square Results**

<b>Chi-square</b>	61.558
<b>Df</b>	7
<b>Significance</b>	.0000

Refer to table 4-5. The model as a whole is significant at the 5% ( $.0000 < .05$ ) level of significance. The null hypothesis that the model is not significant is rejected.

Table 4-6 shows, however, that there are no significant independent variables ( $p < .05$ ). As in the MIDN1 model, the hypothesis specified ( $p. 7$ ) prior to model estimation is valid for gender, academic ranking, and military ranking. These variables are not significant. However, the hypothesis that a technical major is more predictive of NFO assignment than a non-technical major is not accepted. Major is not a significant predictor of service assignment.

**Table 4-6****Variables in the Equation**

Variable	B	S.E.	Wald	df	Sig	R	Exp(B)
GENDER	-.6524	.9453	.4762	1	.4901	.0000	.5208
GROUP2	-.8494	.6751	1.5826	1	.2084	.0000	.4277
GROUP3	.0441	.6662	.0044	1	.9473	.0000	1.0450
AOOM2	-5.8061	29.1454	.0397	1	.8421	.0000	.0030
AOOM3	-8.2618	29.1300	.0804	1	.7767	.0000	.0003
MOOM2	-5.6733	29.2666	.0376	1	.8463	.0000	.0034
MOOM3	-7.6658	29.2533	.0687	1	.7933	.0000	.0005
Constant	16.5224	41.2070	.1608	1	.6884		

Count (n) = 185

### 1. Refining the MIDN2 Model

Although the group2 variable is less than marginally significant, the Wald statistic merits further investigation. The model is reestimated using only the group2 variable. Table 4-7 shows that the group2 major is almost significant at the 5% level. Group two majors decrease (-.8729) the likelihood of being assigned NFO by a factor of .4177. Further research should be conducted in this area to determine why math and science majors reduce the likelihood of being assigned NFO.

**Table 4-7****Variables in the Equation**

Variable	B	S.E.	Wald	df	Sig	R	Exp(B)
GROUP2	-.8729	.4544	3.6894	1	.0548	-.1088	.4177
Constant	2.1812	.2819	59.8509	1	.0000		

Count (n) = 185

**D. BINOMIAL LOGIT ESTIMATION: NFO COMPLETION MODEL**

Dependent variable: NFO

Independent variables: gender, race, group2, group3,  
caqpr1, caqpr3, caqpr4, cmqpr1, cmqpr3, esmbti, inmbti,  
ismbti

Reference variables: group1, caqpr2, cmqpr2, enmbti

**Table 4-8 Variable description for NFO completion model**

<b>Variable*</b>	<b>Values</b>
NFO	1 if designated NFO, 0 if not designated NFO
gender	1 if female, 0 if male
race	1 if Caucasian, 0 if other
group1	1 if engineering, 0 if other
group2	1 if math and science, 0 if other
group3	1 if social sciences and humanities, 0 if other
caqpr1	1 if caqpr 2.00 - 2.49, 0 if other
caqpr2	1 if caqpr 2.50 - 2.99, 0 if other
caqpr3	1 if caqpr 3.00 - 3.49, 0 if other
caqpr4	1 if caqpr 3.50 - 4.00, 0 if other
cmqpr1	1 if cmqpr 2.50 - 2.99, 0 if other
cmqpr2	1 if cmqpr 3.00 - 3.49, 0 if other
cmqpr3	1 if cmqpr 3.50 - 4.00, 0 if other
enmbti	1 if extravert / intuition, 0 if other
esmbti	1 if extravert / sensing, 0 if other
inmbti	1 if introvert / intuition, 0 if other
ismbti	1 if introvert / sensing, 0 if other

\* Definitions for each variable can be found in appendix A

**Table 4-9 Chi -square results**

<b>Chi-square</b>	20.391
<b>df</b>	12
<b>Significance</b>	.0600

As shown in table 4-9 above, the equation is not quite statistically significant because the significance value (0.06) is greater than the accept/reject criteria level of .05 (5%). The model is significant at the 10% level (.06 < .10).

The logistic regression also measures the significance of each independent variable (table 4-10). Viewing the column labeled 'Sig,' all variables except cmqpr1 are insignificant ( $p > .05$ ).

**Table 4-10**                      **Variables in the Equation**

Variable	B	S.E.	Wald	df	Sig	R	Exp(B)
RACE	.3784	.2934	1.6639	1	.1971	.0000	1.4600
GENDER	-.1346	.4506	.0893	1	.7651	.0000	.8740
GROUP2	-.2036	.2890	.4963	1	.4811	.0000	.8158
GROUP3	-.2168	.2599	.6961	1	.4041	.0000	.8051
CAQPR1	-.0163	.3764	.0019	1	.9654	.0000	.9838
CAQPR3	.3799	.2810	1.8281	1	.1763	.0000	1.4622
CAQPR4	-.1011	.3996	.0640	1	.8003	.0000	.9039
<b>CMQPR1</b>	<b>-.8103</b>	<b>.2990</b>	<b>7.3430</b>	<b>1</b>	<b>.0067</b>	<b>-.1015</b>	<b>.4447</b>
CMQPR3	.1362	.3382	.1621	1	.6873	.0000	1.1459
ESMBTI	.0714	.2952	.0585	1	.8090	.0000	1.0740
INMBTI	.0446	.3144	.0201	1	.8873	.0000	1.0456
ISMBTI	.1875	.3139	.3567	1	.5503	.0000	1.2062
Constant	.8152	.3767	4.6839	1	.0304		

Count (n) = 457

The hypothesis specified before the model was estimated is valid for most of the variables. Race, gender, academic grades (caqpr), and major (group 1, 2, 3) are not significant predictors of completing NFO flight training. However the hypothesis that military ranking (cmqpr) is not

significant is rejected. Mcqpr1 (table 4-10) is a highly significant (.0067) predictor of NFO completion. It is significant at the 1% level. It is also hypothesized that extraverted/sensing (esmbti) types have higher completion rates because of a congruence between personality and job (aviation). Table 4-13 shows that MBTI (personality type) is not a significant predictor of completing flight training.

#### **1. Interpretation of the Coefficient for 'cmqpr1.'**

To interpret the coefficient value for 'cmqpr1' in table 4-13, the *B* coefficient column contains the effect of a one-unit change in each independent variable on the log of odds. This column also shows whether a variable, if significant, has a positive (+) or negative (-) effect on the dependent variable. The *Exp (B)* column computes the exponentiated value of *B* so that this value expresses the effect of a unit change in the independent variable on the relevant odds. Since the *B* column is negative, midshipmen ranked in the bottom third (2.50 - 2.99), by military quality point rating, have a lower NFO completion rate compared to the reference variable cmqpr2 (3.00-3.49).

## 2. The Refined NFO Completion Model

The NFO completion regression suggests that a midshipman with a higher military ranking (cmqpr2 as reference variable) is more likely to complete NFO flight training than a mid ranked in the bottom third in military ranking (cmqpr1). It is interesting to see if the cmqpr3 variable is also significant when the reference variable is changed to cmpqr1.

**Table 4-11 Chi -square results**

<b>Chi-square</b>	19.833
<b>df</b>	9
<b>Significance</b>	.0190

Refer to table 4-11 above. After substituting the reference variable cmqpr1 in place of cmqpr2 and removing the MBTI indicator variables, the equation now has a better overall fit than the first NFO completion model. The value (0.0190) is now significant at the 5% level and almost at the 1% level (.0190 = 1.90%).

The significance for each independent variable is listed in table 4-12.



**Table 4-12****Variables in the Equation**

Variable	B	S.E.	Wald	df	Sig	R	Exp(B)
RACE	.3838	.2906	1.7443	1	.1866	.0000	1.4678
GENDER	-.2729	.4275	.4073	1	.5233	.0000	.7612
GROUP2	-.2187	.2829	.5974	1	.4396	.0000	.8036
GROUP3	-.2129	.2551	.6960	1	.4041	.0000	.8083
CAQPR1	-.0175	.3621	.0023	1	.9614	.0000	.9826
CAQPR3	.4053	.2782	2.1237	1	.1450	.0153	1.4998
CAQPR4	-.0830	.3963	.0438	1	.8342	.0000	.9204
CMQPR2	.7756	.2931	7.0010	1	.0081	.0975	2.1720
CMQPR3	.9231	.4244	4.7297	1	.0296	.0720	2.5170
Constant	.0917	.3678	.0621	1	.8032		

Count (n) = 457

Note that in the refined NFO completion model, cmqpr2 is significant at the .01 level and cmqpr3 at the .05 level of significance. The size and significance of the coefficients of the cmqpr variables strongly suggests that the higher ones military standing, the more likely one is to complete NFO training.

The Wald statistic again suggests that race and the caqpr3 variable warrant further investigation. The model is run with the race and caqpr variables plus the cmqpr2 and cmqpr3 variables. The regression analysis in Tables 4-13 (race and caqpr3) and 4-14 (caqpr3) show that race and cacpr3 are still not significant predictors of NFO completion.

**Table 4-13****Variables in the Equation**

Variable	B	S.E.	Wald	df	Sig	R	Exp(B)
RACE	.3700	.2869	1.6631	1	.1972	.0000	1.4477
CAQPR3	.4176	.2553	2.6752	1	.1019	.0358	1.5183
CMQPR2	.8017	.2876	7.7692	1	.0053	.1047	2.2293
CMQPR3	.9425	.3759	6.2878	1	.0122	.0903	2.5664
Constant	-.0771	.3091	.0622	1	.8030		

Count (n) = 457

**Table 4-14****Variables in the Equation**

Variable	B	S.E.	Wald	df	Sig	R	Exp(B)
CAQPR3	.4216	.2549	2.7362	1	.0981	.0374	1.5244
CMQPR2	.8673	.2826	9.4179	1	.0021	.1187	2.3804
CMQPR3	1.0440	.3668	8.0989	1	.0044	.1077	2.8405
Constant	.1680	.2433	.4770	1	.4898		

Count (n) = 457

Tables 4-15 and 4-16 depict the final NFO completion model. Table 4-15 shows that the model as a whole is highly significant; not only at the measured 5% level but also below the 1% level ( $.0009 < .01$ ). Excluding all insignificant variables, the cmqpr variables (table 4-16) are even more significant than in the original model (table 4-10). The mcqpr variable predicts at a less than .01 level of statistical significance that the higher ones military quality point rating, the greater the likelihood of completing flight school.

**Table 4-15            Chi-square Results**

<b>Chi-square</b>	13.971
<b>df</b>	2
<b>Significance</b>	.0009

**Table 4-16            Variables in the Equation**

Variable	B	S.E.	Wald	df	Sig	R	Exp (B)
CMQPR2	.9587	.2776	11.9258	1	.0006	.1373	2.6082
CMQPR3	1.1827	.3578	10.9259	1	.0009	.1302	3.2631
Constant	.2036	.2420	.7077	1	.4002		

Count (n) = 457

#### **E.        SUMMARY**

The service selection (MIDN1) and service assignment models (MIDN2) support the specified hypothesis that gender, academic ranking (aoom), and military ranking (moom) are not significant predictors of service selection. This is consistent with Arcement's study which also found no significance in academic or military order of merit. It also supports the hypothesis that major is not a significant predictor of service selection. Regression analysis shows that both models are not significant predictors of service selection or service assignment.

The MIDN2 model does not accept the hypothesis that a technical major is a better predictor of NFO service assignment than a non-technical major. For example, there does not seem to be a bias in assigning more NFO billets to

engineering majors (group1) than to humanities' majors (group3). However, when regression is run on only the math and science majors' variable (group2), it shows significance around the 5% level. There is a decreasing likelihood of being assigned NFO if one selects one of these majors. At least for NFO service assignment (MIDN2), the regression analysis differs from previous literature (Arcement) which found significance in a shift from group one to either group two or three majors decreases the likelihood of selecting aviation. This study (Arcement 1998, p. 58) included service assignments for both pilots and NFOs when analyzing the aviation community.

It is important to emphasize, however, that in the MIDN2 model, 161 out of 185 observations receive their first choice of NFO indicating selectivity bias. A logit regression should contain a reasonable representation of both alternative choices (Studenmund, p. 512). Most midshipmen (87.0%) receive their first or second choice if it is NFO. As the service assignment data does not contain a reasonable representation of both choices, further analysis of this issue is needed when a larger data set is available.

The NFO completion model supports the specified hypothesis that gender, race, academic grades, and major are not significant predictors of completing flight training. It

is possible that low observation counts, e.g. for race other than Caucasian, and for females, account for the insignificance of these variables. Personality (MBTI) is not a significant predictor of completing training. Therefore the original hypothesis is not rejected. The most interesting result is the military grade variable, cmqpr, which is a significant predictor of NFO completion. Thus, the null hypothesis of no significance is rejected. The cmqpr variable shows that the higher ones military ranking, the greater the likelihood of completing NFO flight training. This result may also be useful information when reviewing the weighting of academic and military grades since both variables are used in calculating overall standing, which is considered when determining service assignment.

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## V. CONCLUSIONS AND RECOMMENDATIONS

### A. CONCLUSIONS

The purpose of this study is threefold. The first (MIDN1) and second (MIDN2) models attempt to determine whether academic grades, military grades, and major are predictive of service selection and assignment. The goal of the third model (NFO completion) is to determine whether academic and military grades, major, personality, gender, and race predict completion of NFO flight training.

The service assignment model (MIDN2) fails to accept the hypothesis that academic major is a significant predictor of service assignment. There is no correlation between a group one, two, or three major and the likelihood of receiving NFO as one's first or second choice. Although not statistically significant, the preliminary analysis for the service assignment model (MIDN2) shows that graduates, who are ranked in the top two-thirds in military and academic orders of merit, are assigned NFO as either their first or second choice. The lack of statistical significance, however, indicates that further analysis is needed.

In the NFO completion model, logistic regression is used to determine statistical significance of the independent variables and test the hypothesis that gender,

race, academic and military grades, and college major are not significant predictors of completing flight officer training. Another hypothesis tested is that extraverted/sensing personalities, those who are more inclined toward practical application and quick decision making, are more likely to complete flight training than other personality types. The regression results show that gender, race, academic grades, and major are not significant predictors of completing flight training, supporting the initial hypothesis. However, the model rejects the hypothesis that: 1. military grades are not significant, and 2. extraverted/sensing personalities are more likely to complete NFO training than other personalities. Personality (Myers Briggs Type Indicator) proves to be an insignificant predictor of completing flight training. The most interesting finding is that military grades are significant at a .01 level of statistical significance. The higher an Academy graduate's military grades (cmqpr), the more likely a graduate will complete flight officer training.

#### **B. LIMITATIONS OF THE STUDY**

Limitations often arise when studies omit important statistical controls that attempt to explain performance measures such as completion of flight training (Mehay, 1995,



p. 3). The Aviation Selection Test Battery (ASTB) has a strong impact on the selection of future aviators. These tests are the primary means used to determine suitability for aviation duty. The three scores used to select candidates for flight officer programs should be included in future analysis. They are not included in this study because of the unavailability of the data. Furthermore, the latest version of the test (1992) is constructed differently than previous tests.

Another weakness of the study is the lack of personal information on why a particular community is listed as first or second choice. An analysis of the relation between NFO completion rates and assignment of NFO as first or second choice cannot be properly conducted without identifying individual reasons for service selection choice. For example, additional information would be required to determine if a midshipman selects NFO as a first or second choice because of bad eyesight, thereby excluding the opportunity to choose a pilot billet as an option.

### **C. RECOMMENDATIONS**

USNAINST 1531.51A Mar 1996 provides a table (p. 2) of the weighting of courses used to compute a midshipman's class standing (Order of Merit). Academic and professional

course grades count for 64.48% of the Order of Merit (OOM) multiple computation, physical education (6.66%), athletic performance (3.38%), military performance (17.68%), and conduct (7.80%). All of the above factors except academic courses are used to determine the professional military quality point rating (mqpr) and are assigned a lower weighting than academic courses. The NFO completion model shows that military grades are significant predictors of completing flight officer training. Academic grades are not significant predictors of completing flight officer training. At least for those graduates who are assigned NFO, there is an association between completing flight officer training and one's physical, military, and moral development, which are measured in the mqpr variable. Further research is required to determine if military quality point rating is a significant factor for other warfare communities. Both academic and military performance are factors considered during service assignment. Therefore, a review of the relative weightings used by the selection board to make NFO assignments is recommended.

## APPENDIX A

### DESCRIPTION OF VARIABLES

Variable	Definition
ethnic	1 = af, 2 = as, 3 = ca, 4 = fi, 5 = hi, 6 = na, 7 = pu
race	1 if Caucasian, 0 if other
af	African-American, 1 if af, 0 if other
as	Asian-American, 1 if as, 0 if other
ca	Caucasian, 1 if ca, 0 if other
hi	Hispanic, 1 if hi, 0 if other
ce	combined ethnicity: Filipino (fi), Native American (na), and Puerto Rican (pu). 1 if ce, 0 if other
gender	1 if female, 0 if male
aoom	academic order of merit (academic class rank) 1 - 979, 1 = highest rank, 979 = lowest
aoom1	1 if aoom 1 - 323, 0 if other
aoom2	1 if aoom 324 - 646, 0 if other
aoom3	1 if aoom 647 - 980, 0 if other
caqpr	Cumulative academic point rating. Equivalent to the grade point average system (GPA) on a scale of 0.00 to 4.00. Includes only academic courses; 1 = 2.00 - 2.49, 2 = 2.50 - 2.99, 3 = 3.00 - 3.49, 4 = 3.50 - 4.00
caqpr1	1 if caqpr, 2.00 - 2.49, 0 if other
caqpr2	1 if caqpr, 2.50 - 2.99, 0 if other
caqpr3	1 if caqpr, 3.00 - 3.49, 0 if other
caqpr4	1 if caqpr, 3.50 - 4.00, 0 if other
moom	military order of merit (military class rank) 1 - 980, 1 = highest, 980 = lowest
moom1	1 if moom 1 - 323, 0 if other
moom2	1 if moom 324 - 646, 0 if other
moom3	1 if moom 647 - 980, 0 if other

## APPENDIX A CONT.

### DESCRIPTION OF VARIABLES

cmqpr	Cumulative military point rating. MQPR is a combination of grades on a scale of 0.00 - 4.00 in the following disciplines: physical education, athletic performance, military performance, military conduct, and professional development grades. 1 = 2.50 - 2.99, 2 = 3.00 - 3.49, 3 = 3.50 - 4.00
cmqpr1	1 if cmqpr, 2.50 - 2.99, 0 if other
cmqpr2	1 if cmqpr, 3.00 - 3.49, 0 if other
cmqpr3	1 if cmqpr, 3.50 - 4.00, 0 if other
major	1 = group1, 2 = group2, 3 = group3
group1	Engineering majors: aerospace (EAS), electrical (EEE), mechanical (EME), systems (ENA), general (EGE), marine (ESP), ocean (EOE), and naval architecture (ESE). 1 if group1, 0 if other
group2	Chemistry (SCH), computer science (SCS), oceanography (SOC), general science (SGS), mathematics (SMA), and physics (SPH). 1 if group2, 0 if other
group3	Economics (FEC), english (HEG), history (HHS), and political science (FPSH). 1 if group3, 0 if other
mbti	1 = enmbti, 2 = esmbti, 3 = inmbti, 4 = ismbti
enmbti	Extravert / intuitive type; 1 if enmbti, 0 if other
esmbti	Extravert / sensing type; 1 if esmbti, 0 if other
inmbti	Introvert / intuitive type; 1 if inmbti, 0 if other
ismbti	Introvert / sensing type; 1 if ismbti, 0 if other

## APPENDIX B

### MIDN1 MODEL

\*see Appendix A for variable description

#### (1) Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
MIDN1	1828	.00	1.00	.1953	.3965
Gender	1828	0	1	.13	.34
GROUP1	1828	.00	1.00	.3873	.4873
GROUP2	1828	.00	1.00	.2489	.4325
GROUP3	1828	.00	1.00	.3638	.4812
AOOM1	1828	.00	1.00	.3425	.4747
AOOM2	1828	.00	1.00	.3463	.4759
AOOM3	1828	.00	1.00	.3113	.4631
MOOM1	1828	.00	1.00	.3452	.4756
MOOM2	1828	.00	1.00	.3496	.4770
MOOM3	1828	.00	1.00	.3053	.4606
Valid N (listwise)	1828				

II.

III.

#### IV. Frequency Table

V.

#### VI. MIDN1

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	others	1471	80.5	80.5	80.5
	ssNF01/2	357	19.5	19.5	100.0
	Total	1828	100.0	100.0	

VII.

VIII.

#### IX. Gender

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	male	1582	86.5	86.5	86.5
	female	246	13.5	13.5	100.0
	Total	1828	100.0	100.0	

## X. APPENDIX B CONT.

### XI. Major

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	group1	708	38.7	38.7	38.7
	group2	455	24.9	24.9	63.6
	group3	665	36.4	36.4	100.0
	Total	1828	100.0	100.0	

### AOOM

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	aoom1	626	34.2	34.2	34.2
	aoom2	633	34.6	34.6	68.9
	aoom3	569	31.1	31.1	100.0
	Total	1828	100.0	100.0	

### XII. MOOM

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	moom1	631	34.5	34.5	34.5
	moom2	639	35.0	35.0	69.5
	moom3	558	30.5	30.5	100.0
	Total	1828	100.0	100.0	

## APPENDIX C

### MIDN2 MODEL

#### Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
MIDN2	185	.00	1.00	.8703	.3369
Gender	185	0	1	.11	.31
GROUP1	185	.00	1.00	.4162	.4943
GROUP2	185	.00	1.00	.2541	.4365
GROUP3	185	.00	1.00	.3297	.4714
AOOM1	185	.00	1.00	.3514	.4787
AOOM2	185	.00	1.00	.3081	.4630
AOOM3	185	.00	1.00	.3405	.4752
MOOM1	185	.00	1.00	.3514	.4787
MOOM2	185	.00	1.00	.3081	.4630
MOOM3	185	.00	1.00	.3405	.4752
Valid N (listwise)	185				

### XIII. Frequency Table

#### MIDN2

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	ssNFO1/2&notsa	24	13.0	13.0	13.0
	ssNFO1/2&sa	161	87.0	87.0	100.0
	Total	185	100.0	100.0	

#### Gender

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	male	165	89.2	89.2	89.2
	female	20	10.8	10.8	100.0
	Total	185	100.0	100.0	

## APPENDIX C CONT

### Major

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	group1	77	41.6	41.6	41.6
	group2	47	25.4	25.4	67.0
	group3	61	33.0	33.0	100.0
	Total	185	100.0	100.0	

### AOOM

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	aoom1	65	35.1	35.1	35.1
	aoom2	57	30.8	30.8	65.9
	aoom3	63	34.1	34.1	100.0
	Total	185	100.0	100.0	

### MOOM

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	moom1	65	35.1	35.1	35.1
	moom2	57	30.8	30.8	65.9
	moom3	63	34.1	34.1	100.0
	Total	185	100.0	100.0	



## APPENDIX D

### NFO COMPLETION MODEL

\*see Appendix A for variable description

#### Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
NFO	457	0	1	.74	.44
AF	457	.00	1.00	3.063E-02	.1725
AS	457	.00	1.00	4.595E-02	.2096
CA	457	.00	1.00	.8446	.3626
HI	457	.00	1.00	5.908E-02	.2360
CE	457	.00	1.00	1.969E-02	.1391
GENDER	457	0	1	6.56E-02	.25
CAQPR1	457	.00	1.00	.1007	.3012
CAQPR2	457	.00	1.00	.4639	.4992
CAQPR3	457	.00	1.00	.3129	.4642
CAQPR4	457	.00	1.00	.1225	.3283
CMQPR1	457	.00	1.00	.1510	.3584
CMQPR2	457	.00	1.00	.6521	.4768
CMQPR3	457	.00	1.00	.1969	.3981
GROUP1	457	.00	1.00	.4333	.4961
GROUP2	457	.00	1.00	.2254	.4183
GROUP3	457	.00	1.00	.3414	.4747
ENMBTI	451	.00	1.00	.3149	.4650
ESMBTI	451	.00	1.00	.2705	.4447
INMBTI	451	.00	1.00	.1996	.4001
ISMBTI	451	.00	1.00	.2151	.4113
Valid N (listwise)	451				

# APPENDIX D CONT.

## FREQUENCY TABLE

### NFO

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not NFO	120	26.3	26.3	26.3
	NFO	337	73.7	73.7	100.0
	Total	457	100.0	100.0	

### ETHNIC

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	AF	14	3.1	3.1	3.1
	AS	21	4.6	4.6	7.7
	CA	386	84.5	84.5	92.1
	FI	6	1.3	1.3	93.4
	HI	27	5.9	5.9	99.3
	NA	1	.2	.2	99.6
	PU	2	.4	.4	100.0
	Total	457	100.0	100.0	

### GENDER

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	M	427	93.4	93.4	93.4
	F	30	6.6	6.6	100.0
	Total	457	100.0	100.0	

# APPENDIX D CONT.

## CAQPR

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	acqpr1	46	10.1	10.1	10.1
	acqpr2	212	46.4	46.4	56.5
	acqpr3	143	31.3	31.3	87.7
	acqpr4	56	12.3	12.3	100.0
	Total	457	100.0	100.0	

## CMQPR

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	cmqpr1	69	15.1	15.1	15.1
	cmqpr2	298	65.2	65.2	80.3
	cmqpr3	90	19.7	19.7	100.0
	Total	457	100.0	100.0	

## MAJOR

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	group1	198	43.3	43.3	43.3
	group2	103	22.5	22.5	65.9
	group3	156	34.1	34.1	100.0
	Total	457	100.0	100.0	

## MBTI

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	enmbti	142	31.1	31.5	31.5
	esmbti	122	26.7	27.1	58.5
	inmbti	90	19.7	20.0	78.5
	ismbti	97	21.2	21.5	100.0
	Total	451	98.7	100.0	
Missing	System	6	1.3		
Total		457	100.0		

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